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been much rivalry in electric lighting, and three of the most important companies — the Edison, the Westinghouse, and the Thomson-Houston — are at swords' points, and much of the current technical literature consists of discussions as to the merits and demerits of the various systems.

But it is in the extension of power-distribution by means of electricity that the year has been most memorable. Large numbers of electric motors have been installed for supplying powers from $\frac{1}{4}$ to 40 or 50 horse-power, and these are fed from the local lighting companies, and have displaced small steam and gas engines. The uses to which they have been applied are innumerable, and they are increasing in favor as their economy and efficiency become more apparent. More ambitious installations have been carried out in the Western mining districts; the most noteworthy being the power plants at Aspen, Col., and on the Feather River in California, where the Sprague Company has transmitted power (in the last case a distance of nine miles), and at Virginia City, where the Brush Company has just effected an installation. Electric street-railways have more than kept pace with stationary motor-work. The first large road equipped was the Richmond road of the Sprague Company, the largest and most difficult installation that had ever been attempted. After numerous disappointments, and after overcoming difficulties that would have disheartened any less energetic and efficient company, the road was successfully opened in March, and has been running without interruption ever since. There is little doubt that to the success of this tramway is due the boom in electric-motor cars, that has given the Sprague and other companies a business even greater than their large capacity. The Sprague Company has finished or is equipping thirty street-railways; the Thomson-Houston Company, as many more; while the Daft Company has under way or finished a dozen or fifteen. All of these roads have overhead wires to convey the current from the dynamos to the motors. It is probable that the ultimate system of street-car traction will be by storage-batteries on the car, supplying current to motors beneath them, geared to the axles. During the year there has been little progress in this system of traction. One or two cars are being run in New York, in Philadelphia, and in some of the Western cities. The progress has hardly, however, been satisfactory. The present type of storage-cell is heavy and inefficient, and rapidly deteriorates; and the year has not seen the introduction, either here or abroad, of any new type of battery, nor any marked improvement in the old. For exceptionally favorable roads, where there are very light grades, storage-battery cars will cost about the same as horses, or perhaps a little less; but there are few such in the States.

No important inventions in industrial electricity have been developed during the year, although several very promising ones have been patented, and are being improved and tested. The Tesla motor for alternating currents is being developed by the Westinghouse Company; several plans for continuous-current conversion are being experimented on; new types of storage-battery have been described, and will possibly prove successful. Nothing important has been done in the telephone line. In telegraphy Professor Gray has developed a writing-telegraph, which will possibly do what is claimed for it, but which seems very complicated.

There has been much patent litigation, and important decisions have been rendered here and abroad. In an English suit Edison's fundamental patent on carbon filaments for incandescent lamps was badly damaged, although the decision has been appealed from, and it is again being tried. The patents of the Westinghouse Company for the alternating system have been decided against, both in England and this country. The Supreme Court has decided that the government has the right to bring suit against the Bell Telephone Company to annul Bell's patent, but this decision is of interest only as establishing the general right of the government to bring such a suit. A number of important suits are pending on patents for storage-batteries, incandescent lamps, systems of distribution, etc.; and after the holidays a case before the Supreme Court will decide whether Edison's fundamental patents on electric lighting have expired with the limit of the foreign patents.

On the whole, the year has been one of solid advance and improvement, but with no startling development nor revolutionary discovery.

THE SCIENTIFIC WORK OF THE JOHNS HOPKINS UNIVERSITY.

IN considering the scientific work at the university, President Gilman laid emphasis, in his recent annual report, on those parts of the work which are of widest interest, especially on the investigations and publications which have been encouraged, and the opportunities afforded for the education of advanced students. The trustees and the faculty of such an institution need frequently to recur to general principles, ask themselves what they have undertaken to do, and carefully weigh the results of their labors. Accordingly a brief restatement of some of the considerations by which they have been influenced introduces the record of the year. Far more important than the formal lectures and recitations of a university are the intellectual influences which it affords, — the attractions of its libraries and laboratories; the spirit which animates the professors; the conditions upon which degrees, fellowships, and other academic honors are bestowed; the connection existing between the studies of the place and the studies that are in progress in other seats of learning; and the prospects which are open to young men of character and scholarship at the end of their courses. The university which imparts to a large number of students good impulses, disciplines them with thorough training, encourages them with judicious counsel, and upholds before them lofty ideals, becomes an agency of great power in the advancement of the general welfare. It annually sends to every part of the land, into all the professions, into professorships, masterships, and other leaderships, those who are likely to be centres of light and influence in their various states.

The opening of this university occurred in 1876, at a time when many careful writers were engaged in the study of the progress of the United States during the first hundred years of national life. Important articles then published, on the state of the arts and sciences in America, and on the condition of American education, were carefully considered by those who were engaged in planning the new institutions in Baltimore. Among such papers there was one entitled 'Abstract Science in America,' by Professor Newcomb, which indicated "the points of view from which our claims to be an intellectual nation look very slender indeed." The writer acknowledged the excellent quality of the work which was done by the leaders of American science, while he lamented the want of encouragement to engage in such labors. He declared that "we are deficient in the number of men actively devoted to scientific research of the higher types, in public recognition of the labors of those who are so engaged, in the machinery for making the public acquainted with their labors and their wants, and in the preliminary means for publishing their researches." He continued to say, —

"Each of these deficiencies is to a certain extent both cause and an effect of the others. The want of public recognition and appreciation is due partly to a want of system and organization, partly to the paucity of scientific publications. The paucity of research is largely due to the want of adequate reward in public estimation and recognition; while the paucity of scientific publications is due to the want of an adequate number of supporters. The supply of any one of these deficiencies would, to a certain extent, remedy all the others; and, until one or more are so remedied, it is hopeless to expect any great improvement. In other intellectual nations, science has a fostering mother, — in Germany the universities, in France the government, in England the scientific societies; and, if science could find one here, it would speedily flourish. The only one it can look to here is the educated public; and, if that public would find some way of expressing in a public and official manner its generous appreciation of the labors of American investigators, we should have the best entering wedge for supplying all the wants of our science.

"The other way in which help could be most effectively given at small expense is by the support of two or three first-class journals of exact science. We say exact science, because this is the department which is worst supplied in this respect. Taking mathematics at one extreme, and medicine at the other, we can pretty accurately gauge the exactness of each science by the difficulty its cultivators find in supporting journals devoted to it. It may seem like reducing our thesis to the ridiculous to say that our wants in this

respect could be well supplied at a cost of five or six thousand dollars per annum, and that the future prospects of the mathematical sciences in this land depend very largely on their cultivators being able to command this annual sum for the purpose indicated."

In two of the particulars just mentioned — the encouragement of advanced studies and the publication of results — this foundation has aimed to do its part. By precept and example, hundreds of young men have been trained in the methods of exact science and the habits of accurate investigators. Not a few of these students have been called into the scientific service of the government; many are engaged in laboratories, scientific and technical; more are employed as teachers in training up other young men. The university can point to no result of its efforts which is so gratifying, and which so thoroughly repays the outlays of this foundation, as the corps of graduates who have gone out to every part of the country, prepared to contribute to the progress of knowledge, and who are now rendering good service to science, literature, and education. By encouraging the publication of journals and monographs, this foundation has endeavored to supply another of the deficiencies referred to above. Five periodicals, devoted to mathematics, chemistry, biology, philology, and history, have been aided by the university chest; and three others, devoted to archæology, psychology, and modern languages, have been initiated on the personal responsibility of certain members of the academic staff.

President Gilman then considered the higher aspects of the work of the university, especially during the last session.

The subject of mathematics has received a large amount of attention in the years gone by, as every one knows who remembers the seven years' leadership of Professor Sylvester, the special courses given by Professor Cayley and Sir William Thomson, and the continued instruction of the present staff of mathematicians. Every one that has an appreciation of the nature of mathematical thought, or of its relation to the advancement of science, must rejoice that this has been so. Dr. Whewell once claimed that mathematics and civilization go forward hand in hand; and quite recently Lord Rayleigh, in reply to some contrary assertions, has said that although some mathematicians are unpractical, yet it is to mathematics one must go to find the results of known causes under new circumstances.

It has always been a surprise to President Gilman that so few Americans are interested in the new and advancing developments of this science, and that so large a number of those who are giving their lives to mathematical professorships prefer to walk in well-trodden paths without attempting to follow the higher flights of the leaders. The number of mathematical students at Johns Hopkins has never been large; but the teachers continue to offer varied advanced courses attractive to a superior class of students, and those who graduate in this subject are not often obliged to wait for a vocation. In addition to the usual number of mathematical lectures, stated in the appendix, there has been a noteworthy advance during the past year in the facilities for the study of astronomy, theoretical and practical, and there has been a considerable increase in the number of students.

An observatory for instruction is now provided. Besides the telescope mentioned in the last report, the university has purchased a meridian circle (made by Messrs. Fauth & Co. of Washington), with collimators, mercury basin, and other appliances. To receive this instrument, a special structure has been built adjacent to the physical laboratory. A class in practical and theoretical astronomy has been organized under the guidance of Prof. Simon Newcomb, for many years connected with the Naval Observatory in Washington, and now superintendent of the United States 'Nautical Almanac.' During the coming year he will be assisted by Mr. Charles A. Borst, lately one of the astronomical observers of Hamilton College, who has received the appointment of a fellow.

From these statements it is apparent that the university is now provided with the most important of the astronomical apparatus suggested many years ago by Professor Newcomb, in one of his public lectures, as desirable for the practical instruction of astronomers. It has also the qualified teachers, and a company of students has begun the prescribed course. The further development of this department of study will be watched with great interest. Its distinctive character is its adaptation to the needs of young men, already pro-

ficient in mathematics, who need to be trained in the methods of astronomical inquiry, and who want easy and constant access to suitable instruments, as they have in the laboratories of chemistry and physics.

One leading idea of the work is to associate with the technical study of the subject a greater breadth of culture than can readily be gained by the student whose attention is wholly occupied by practical work in the observatory or the field. It is therefore intended that all students taking the doctor's degree in astronomy as their principal subject, shall have an understanding of the historic development of the science since its beginning, of the additions made to it by its leading cultivators, of the mathematical theories of the celestial motions, and of the practical use of the most important astronomical instruments.

The *American Journal of Mathematics*, of which Professor Newcomb is editor, and Associate Professor Craig the assistant and managing editor, has completed its tenth volume, and an index of the contents of the entire series has been prepared for publication. Eight of the contributors to the tenth volume are Americans; four reside in England; four in France; and one each in Canada, Italy, and Germany.

The mathematical staff remains as it has been for several years past, Drs. Story, Craig, and Franklin being associated with Professor Newcomb.

The new physical laboratory justifies the expectations which led to its construction, not merely in view of the increased facilities it affords for instruction, but also for the greater efficiency with which investigations are carried on.

During the past year, Professor Rowland has continued to devote much attention to the study of the solar spectrum, and the preparation of a new edition of his photographic map. The new ruling-engine, which was completed a year ago, has been placed in the vault prepared for it, where the temperature is equable; and, after months of laborious adjustments and connections, the machine has been so perfected that it rules gratings of the largest size, surpassing in definition any that have been obtained before. Several concave gratings six inches in diameter, and with a radius of more than twenty-one feet, have been ruled with from ten to twenty thousand lines to the inch, and they have been mounted in a large room especially adapted to their service. It is chiefly due to the excellence of these gratings that the new photographic maps are so superior to the old. Something is due also to the constant attention Professor Rowland has given to photographic methods, and to his skill in making dry plates, simple and orthochromatic. The result of this long and laborious preparation has been the production of a map, soon to be published, of the normal solar spectrum, extending from the extreme ultra-violet (down to and including B) to wave-length 6950.

The director of the laboratory has been greatly favored in the prosecution of his work by the services of the associate professor in physics, Dr. Kimball, who has given for several years past the general course of instruction, and has personally guided the laboratory-work of the students.

The special course of instruction in electricity and magnetism has been in charge of Dr. Duncan, and it has been found to meet the wants of students who have an aptitude for both mathematical and experimental work. Four such persons, after a special course of study extending through two years, and after satisfactory final examinations, received special certificates at Commencement.

With the unusual facilities now enjoyed by Professor Rowland, it is natural that his principal work during the past year has related to the nature of light. Under his guidance, progress has been made in determining the absolute wave-length of light, and the relative wave-lengths of lines in the ultra-violet portion of the solar spectrum. The spectrum of hydrogen has been studied under various conditions of excitement and pressure; and the spectra of zinc, cadmium, and magnesium have been studied photographically and the wave-lengths measured. So, also, various bands of the carbon spectrum from the electric arc have been investigated, an algebraic expression of the relation between their wave-lengths has been obtained, and the coincidence of the bright lines of the carbon spectrum with the dark lines of the solar spectrum has been verified. Additional measurements have been made on the displace-

ment of lines in the solar spectrum due to the rotation of the sun.

Important work has also been going forward with respect to electricity and magnetism. A determination has been made of the unit of electrical resistance by the method of Lorenz, and a study has been made of the electrical resistance of pure mercury with reference to the value of the mercury unit. The curves of electromotive force and current in an alternating dynamo, under varying conditions, have been studied, and also the chemical changes in storage-battery cells, and the behavior of different insulating substances under various conditions.

Arrangements have been matured for the testing of electrical instruments and standards for other laboratories, scientific and industrial. This work, under the supervision of the chief instructors, is intrusted to Dr. Liebig. Correspondence between Dr. Duncan, associate in electricity, on one part, and the leading electric manufacturers and the professors of physics in different parts of the country, on the other, has indicated the need of such a bureau as is now established. Its actual utility will soon be demonstrated.

In this connection President Gilman writes: "I am unwilling to pass on from this subject without endeavoring to arrest the attention of the trustees, and through them the attention of other persons who are observing the development of this university, to the fundamental character of the researches which are here carried on, and to their ultimate relation to the welfare of human society. Costly laboratories, expensive apparatus, numerous assistants, the means of publication, unquestionably call for a great deal of money; and those who are concerned with economical problems have a right to ask what results are to be seen after all this outlay. The answer can readily be given with respect to all departments of science; but just now it is particularly easy to justify the expenses of a physical laboratory, because of the remarkable progress which is making throughout the world in the study of physical phenomena, and the discovery of principles hitherto vaguely perceived or entirely hidden.

"Those who are watching the progress of science are well aware that the year 1888 is memorable for the new evidence which has been brought to the support of Maxwell's electro-magnetic theory of light in the experimental discovery of long waves of electro-magnetic induction moving through the ether with the velocity of light. The papers of Hertz, presented by Helmholtz to the Academy of Sciences in Berlin, and the discussions to which they have given rise in the recent meeting of the British Association and in the scientific journals, are proofs of this remark.

"This is not the place for more than an allusion to such investigations; but some reference to them seemed called for, in order to show that there is constantly even now an advance. The conception of a Faraday, developed by the powerful analysis of a Maxwell, is submitted to the laborious tests of the laboratory; one after another agreements and coincidences are found; facts insignificant in themselves become weighty with importance when seen in their relation to others; and finally some far-reaching result, like that of Hertz, compels belief, and gives to the world a new truth as a part of its inestimable treasure of knowledge, enriching the intellectual life of all who come after.

"Another illustration may be found in the address of Professor Langley at the Cleveland meeting of the American Association. Under the title of 'The History of a Doctrine' (radiant energy), he has unfolded, in terms which are easily followed by 'the non-mathematical reader' (and even by the 'non-scientific'), the steps by which science has reached its present stage, and is still advancing in the discovery and interpretation of a fundamental truth.

"In this progress the work of a laboratory is most important. The photographic maps of the sun spectrum and of the spectra of metals, and the measurement of the wave-lengths of light, among the labors that have engaged our own investigators, relate directly to fundamental questions in physics and chemistry.

"The diffraction gratings devised by Professor Rowland are of prime importance in the prosecution of these studies of light. In all the principal laboratories of the world they are in demand, and consequently their manufacture is continued, although it requires a large amount of personal supervision from the director. The measurement of the mechanical equivalent of heat is a fundamental factor

in establishing the doctrine of the conservation of energy, and lies at the basis of the modern theory of the steam-engine. So, also, the solution of problems in electricity and magnetism, besides giving glimpses into a realm of nature still enshrouded with mystery, has a direct bearing on the welfare of the race, by advancing that knowledge which enables mankind to make the forces of nature obedient slaves.

"My object in thus dwelling upon the returns which have come, and are likely to come, from large expenditures of intellectual force and of financial resources, is to invite attention to an opportunity for the endowment of 'the ——— Institute of Physical Science' in the Johns Hopkins University. The admirable laboratory that has been built and well equipped, from the mechanic's shops in the basement to the telescope in the tower, is in itself an enormous and complex piece of apparatus for the prosecution of researches. Its staff of teachers and investigators are constantly looking to the advancement of knowledge, and maintaining a helpful attitude toward the practical applications of science. A serviceable way to keep up and extend the efficiency of this laboratory would be to provide it with a fund of its own, to be perpetually and exclusively devoted to the advancement and diffusion of knowledge in this special domain. More than a hundred years ago an American citizen, well known as Count Rumford, established in this country and in England large funds for the promotion of investigations in light and heat. The good accomplished by his gifts is incalculable, and the lustre of his name increases as the years roll on. Who will follow his example?

"If there are any friends of the university who are anxious to know what are the practical results of abstract science or of recondite and to them incomprehensible researches respecting energy, let them read these words of Professor Langley, 'The doctrine of radiant energy is reaching out over nature in every direction, and proving itself by the fact that through its aid nature obeys us more and more,—proving itself by such material evidence as is found in the practical applications of the doctrine, in the triumphs of modern photography, in the electric lights in our streets, and in a thousand ways which I will not pause to enumerate;' or these words of Professor Fitzgerald,¹ 'Let us for a moment contemplate what is betokened by this theory that in electro-magnetic engines we are using as our mechanism the ether, the medium that fills all known space. It was a great step in human progress when man learnt to make material machines, when he used the elasticity of his bow and the rigidity of his arrow to provide food and defeat his enemies. It was a great advance when he learnt to use the chemical action of fire; when he learnt to use water to float his boats, and air to drive them; when he used artificial selection to provide himself with food and domestic animals. For two hundred years he has made heat his slave to drive his machinery. Fire, water, earth, and air have long been his slaves; but it is only within the last few years that man has won the battle lost by the giants of old, has snatched the thunderbolt from Jove himself, and enslaved the all-pervading ether.' "

The work of the chemical laboratory, having been well organized for a longer period than that in physics, calls for less comment. Professor Remsen continues to be the director, and Dr. Morse the sub-director, and Dr. Renouf and several younger men are engaged as assistants and teachers. If increasing numbers are an indication of success, there is every reason to be gratified, for during the past year every available place in the laboratory has been occupied. But numerical success is not the best test of any branch of university-work. The readiness with which the young men who have here been taught are called to good positions, sometimes as teachers and sometimes as chemists in technical occupations, is an indorsement more significant than any numerical statement. All the arrangements of the laboratory are adapted to those who desire to devote a long period of time to this study, and those who wish for short and special courses are not encouraged to come here. Three or four years of study is usually required of those who have had already such an undergraduate course as is here given, before they can proceed to the degree of Doctor of Philosophy. The director of the laboratory continues to edit the *American Chemical Journal*, which has now nearly reached the conclusion of its tenth volume,

¹ Address at Bath, Eng., September, 1888.

and has taken its place among the chemical journals of the world as the chief repository of what is accomplished in this country for the advancement of the science.

The geological work in progress at the university is in part petrographical, in part structural, and in part paleontological, in its nature.

The study of interesting chemical and microscopical problems relating to the alterations which certain minerals undergo in the earth's crust, commenced by Dr. Williams five years ago (in the black gabbros occurring west of Baltimore), and published as Bulletin No. 28 of the Geological Survey, has since that time been pursued in widely separated regions. One series of articles on analogous rocks occurring near Peekskill, N.Y., has already appeared, while an extended memoir on similar phenomena observed in the Lake Superior region is now passing through the press in Washington.

At the present time all the varied and complicated crystalline rocks of Maryland, occupying an area of two thousand square miles, are being mapped upon a scale of two inches to the mile. This work has been undertaken in connection with the United States Geological Survey, and is under the direction of Dr. Williams. Chemical and microscopical studies of the rocks are carried on in connection with the field-work.

Dr. W. B. Clark, who has been connected with the university during the past year, is engaged in original research in paleontology.

In response to a request from the university, Major J. W. Powell, director of the United States Geological Survey, has caused to be made a survey of Baltimore and its environs, in general conformity with the scheme which is in progress for making a topographical map of the entire country. The survey of the Baltimore region was intrusted to Mr. Sumner H. Bodfish, topographer of the survey, assisted by Mr. J. H. Jennings, assistant topographer of the survey, and Mr. E. G. Kennedy, and the work is now nearly ready for publication.

The past year has seen improved organization in the department of psychophysics, and likewise the unexpected interruption of its activity. Suitable rooms for experimental work were provided in the physical laboratory, instruments and apparatus were bought, and the services of an associate well trained in the methods of physiological inquiry were enlisted. Arrangements were perfected for clinical observations and for the examination of pathological conditions of the nervous system. Nor were the wider aspects of psychology neglected; the history of philosophy and the principles of pedagogics were taught. The publication of the *American Journal of Psychology* was begun, with the financial encouragement of a liberal friend. An increasing number of well-qualified students were attracted by the learning, the enthusiasm, and the sympathy of Professor Hall. Near the close of the academic year, he received an invitation to become the head of Clark University. No successor has as yet been nominated.

Since the foundation of this university, the biological sciences have received special encouragement, partly because of the rapid advances that they have been making, and partly because of their relation to the progress of modern medicine. Prolonged courses of training are arranged for those who propose to devote their lives to investigation or to teaching in these branches, as well as for those who intend at a later period to study for the profession of physicians and surgeons. As in physics and chemistry, abundant facilities for laboratory-work are called for; instruments, materials, and assistants have been and must be liberally provided.

The science of biology includes the study of the forms and functions of living beings in their normal conditions, or, in other words, physiology and morphology; and in both these departments animal and vegetable life must be studied. Professor Martin, director of the biological laboratory, gives his chief attention to physiology; and Dr. Brooks, director of the marine laboratory, to morphology. Dr. Howell, now associate professor, is the chief assistant in biology; and during the past year aid has also been received from Dr. Andrews, Dr. Barton (in botany), and others.

In considering the work of the session, mention will be first made of the courses that are planned for beginners. The director believes that such students have never been more efficiently taught

than during the past year, and the result is indicated by an increase in the number enrolled for the session of 1888-89. When it becomes understood that a medical education should always be based upon an intimate acquaintance with the laws of life and the activities of normal and healthy beings, young men will not fail to avail themselves of such preliminary training as is here afforded; but, as most of the medical schools of this country prescribe no conditions of scholarship as essential for beginners, it is no wonder that the number of future physicians who are willing to take preparatory instruction in biology is small. It is a great satisfaction, however, to observe that those who have this thorough foundation rise surely and quickly to professional excellence.

The results of many of the original researches in the department have already been published in abstract in the *University Circulars*, the *Zoologischer Anzeiger*, and elsewhere; some of the remainder have been published in full in the *Studies from the Biological Laboratory* and in other journals.

Three numbers of the fourth volume of *Biological Studies* were printed during the year; and a volume containing Dr. Bruce's observations on the embryology of insects and arachnids was issued with the co-operation of his friends in Princeton.

The unusual opportunities which have here been provided for students to become acquainted with the most recent methods of pathological investigation are but little known, partly because of their novelty, and partly because pathology has been usually regarded as a branch of a distinctly professional education. Looking forward to the time when a medical school will be organized, — in close relations to the Johns Hopkins Hospital, on the one hand, and to the philosophical faculty of the university, on the other, — the trustees in 1883 determined to supplement the physiological work already directed by Dr. Martin, with a new department of pathology, in which the most recent and approved methods of research should be introduced. Dr. William H. Welch of New York was appointed professor of this science, and, after a year's residence in Europe, he began the organization of a laboratory in a building (that had been constructed for autopsies) on the grounds of the Johns Hopkins Hospital. All the apparatus required for such investigations has been provided by the trustees. Cultures of a large number of pathogenic micro-organisms have been collected, and likewise a great deal of material illustrative of human and comparative pathology. The laboratory is open and teachers are present during the entire day.

Instruction is given in general pathology and in the special pathological histology of all the organs of the body, in experimental pathology, and in the method of making autopsies. Bacteriology receives a great deal of attention. Students are taught to study the forms, growth, and functions of bacteria and fungi, particularly those which are related to disease. They have also an opportunity to become acquainted with the methods of biological examinations of air, water, etc. There is hardly any branch of human knowledge which is growing so rapidly, and which gives promise of such good fruit, as that which includes the laws of life in health and disease. Education for the medical profession of this country must soon be re-organized in accordance with modern developments. In this re-organization laboratory methods are to play a most important part; and young men who have been trained in physics, chemistry, and general biology are coming up to the school of medicine ready for further scientific studies, especially in the laboratory of pathology. Here, among other subjects, they must be taught the relations of bacteria to disease, and the changes in structure and in function produced by disease in the various organs and tissues of the body. They must be able to understand the discoveries now in progress, to weigh their significance, to see their bearing upon diagnosis and the treatment of disease. Hence it is that at so large a cost this university has given such vigorous support to its school of pathology, and has aimed to equip the laboratory so completely with the requisite apparatus and with the material needed for study.

DR. H. CARRINGTON BOLTON is about to undertake a journey to Egypt. From January 1 to May 1, 1889, letters may be addressed to him, care of Brown, Shipley, & Co., London, England.